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This booklet investigates the problems of evaluating the outcomes of science in general education and is directed specifically to educational objectives in the affective domain. Some insights are presented into the way the affective educational objectives of Krathwohl may be written in behavioral terms. The interrelationship of the affective, cognitive, and psychomotor domains is outlined, and the need for behavioral objectives in science is explained. The affective domain receives special treatment in terms of values and value systems, attitudes, interests, and motivation. Indicator behaviors for affective goals are presented along with a scheme for evaluating affective outcomes. Useful appendices include some examples of (1) affective goals in behavioral terms, (2) test items in the affective domain, and (3) evaluation instruments. (GR)

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Preface

This discussion has developed during two years of effort by members of the National Science Supervisors Association, as they grappled with the problems of evaluating the outcomes from general education in science in recent years. It is hoped that other groups of teachers and supervisors will rise to the challenge presented here and continue the work toward a better understanding of educational objectives in the affective domain.

Educators have found that objectives stated in behavioral terms are more clearly stated than are objectives stated in more traditional ways. Also, it is easier to evaluate the achievement of behaviorally stated objectives.

Educational objectives in the affective domain were described by Krathwohl in Part II of the *Taxonomy of Educational Objectives.* However, these objectives were not expressed in behavioral terms. The purpose of this monograph is to provide some insight into ways in which this can be done and to provide some examples of objectives of this type.

Another problem that is related to objectives in the affective domain is the need for developing scientific literacy in students. It is generally conceded that we can no longer afford the luxury of attempting to educate people to be "scientifically literate" unless we define the term more specifically and identify behaviors which will indicate in an adequate way that we are accomplishing this educational goal.

After studying this monograph, the reader should be able to

1. Explain why objectives in the affective domain are important in science education;
2. Give a list of action verbs that can be used in writing objectives in the affective domain;
3. Give some examples of objectives in the affective domain that are expressed in behavioral terms; and
4. Prepare a means of evaluating the achievement of the stated objectives.

Albert F. Eiss — Mary Blatt Harbeck
NATIONAL SCIENCE SUPERVISORS ASSOCIATION

Foreword

Instructional procedures without stated objectives and goals are likely to result in random and haphazard learning. If the stated objectives are too general, they are of little value to the instructional program, and, if they are too specific, they run the risk of being too restrictive. All agree that objectives and goals are essential; the question becomes, how shall they be stated?

General objectives aimed primarily at factual goals have long been in vogue. Behavioral objectives are currently receiving much attention, but many teachers have had little experience in the formulation of objectives stated in terms of sought and measured behaviors. It is in this area that the monograph which follows hopes to be most helpful.

To say that all objectives must fit into any one model is absurd. It is not even necessary nor desirable that all objectives be prestated; many may evolve during the learning activity, and unexpected desirable goals may be attained, in addition to the preplanned objectives. When the learning experience can be evaluated via performance and improved attitudes exemplified by the participant, we have a desirable situation.

This publication can be of greatest help to the individual teacher by serving as one model for constructing educational objectives and evaluating their outcomes. Any model, at best, is limited and is useful only to the extent that it assists the learner in understanding some phase of a problem that he has not understood previously. The individual teacher can best upgrade his own classroom situation and grow professionally through continuous self-assessment and by asking the questions, "Why did I teach what I did today?" and "How could I have done it better?"

Robert L. Walker, President
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Supervisor of Science
Evanston (Illinois) Township High School

Introduction

In June of 1967 a planning conference was held jointly by the National Science Teachers Association and the National Science Supervisors Association in Washington, D. C., for the purpose of exploring the feasibility of developing a rather special list of terminal objectives in science which might be expected of high school seniors. These behaviors were to reflect "scientific literacy" rather than a competency in science itself. In other words, the group was asked what the goals of science education for every student should be and, furthermore, how could the goals be stated in behavioral terms.

This conference group noted that behavioral objectives were being developed presently in the cognitive domain by other groups. However, in the affective domain of educational objectives, no one was able to report any work being done. Insofar as was known, no one had demonstrated the feasibility of formulating behavioral statements concerning such things as attitudes, interests, and appreciations. Therefore, the conference group itself listed several behavioral descriptions in the affective domain to show that this was possible.

At the conference, plans were made to hold five regional meetings in Philadelphia, Berkeley, Chicago, Wichita, and Atlanta. Approximately fifteen science supervisors would be invited to each regional meeting and provided with working papers in advance (i.e., Mager's *Preparing Instructional Objectives* and an NSTA paper entitled "Developing Categories for Behavioral Objectives").

The tentative agenda for each regional meeting included a brief presentation of the problem: "What do we want scientifically literate high school seniors to be able to do within the affective domain?" Following an introduction called "Why Behavioral Objectives?", the entire group at each regional meeting was asked to agree in principle with a previously prepared statement defining scientific literacy. After this step was taken, the group was asked to divide into subgroups to work independently on one or more of the provided behavior descriptions of their own choosing. The behavior

descriptions were presented under three headings: awareness of conditions, acceptance of values, and preference for values.

Each group attempted to write behavioral objectives and to construct criterion test items as a means of measuring the attainment of each objective. The results of this work were published in a Summary Report issued jointly by the National Science Supervisors Association and the National Science Teachers Association in 1967. Excerpts from that report are in the Appendix of this volume.

Devising, for science education, behavioral objectives which are in the affective domain and which can be measured with any degree of reliability and validity proved to be a very difficult undertaking. Abandoning the attempt to write such objectives was considered, but this idea became increasingly untenable as more and more evidence accumulated which shows that having a scientifically literate citizenry is important. Society seems to be demanding that our educational system provide each student with the skills and attitudes necessary for scientific literacy. It becomes increasingly important, therefore, that we be able to show evidence of this goal being reached and not merely hoped for.

It was decided to attack the problem on a wider scale by planning several conferences of college science teachers to deal with this topic, in addition to the science supervisors conferences. As several small groups of writers (at subsequent college staff and science supervisors conferences) continued to struggle with the assignment of analyzing educational objectives in the affective domain, a different model for learning began slowly to emerge. The purpose of this monograph is to offer this model as a basis for continuing the effort to build and analyze an instructional system that will insure education for scientific literacy.

CHAPTER I | The Learning Process

The Interrelationships of the Affective, Cognitive, and Psychomotor Domains

The purpose of writing objectives is to identify specifically the outcomes of learning that are desired. In classifying educational objectives, Bloom and Krathwohl[1] separated them into three domains: the cognitive, the affective, and the psychomotor. The cognitive domain deals with knowledge and understanding. The affective domain deals with values, attitudes, and interests. The psychomotor domain deals with relatively simple motor skills, like typing and walking, as well as the more complex skills of talking and writing. Although all three of the domains must be considered in designing a learning model, the primary concern was with the affective domain.

There has been general agreement that there are many desirable goals in science education in the affective domain. Many of these are included in such terms as attitudes, appreciations, and interests. Krathwohl[2] has pointed out that these terms are necessarily vague, ranging all the way from awareness of a fact to the conceptualization of a value. In general, educators seem to desire to achieve the higher levels of affective goals in students, including satisfaction in response and developing systems of values.

Values have seldom been stated as goals of science instruction. In fact, many scientists take pride in pointing out that there are no philosophic values in science. To the extent that science is a set of observations and generalizations, this may be considered to be true. But as soon as we consider the process of science and characteristics of scientists, we find that many values are widely held and fondly cherished—if not possessed—by scientists and teachers alike. Such values as honesty in reporting, openmindedness, and the usefulness of evidence in making decisions are very important. These examples may suggest to the reader many other values held by scientists.

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[1] Bloom, Benjamin S., Editor. *Taxonomy of Educational Objectives. Handbook I: Cognitive Domain.* Longmans, Green and Company, New York. 1956.

Krathwohl, David R.; Bloom, Benjamin S.; and Masia, Bertram B. *Taxonomy of Educational Objectives. Handbook II: Affective Domain.* David McKay Company, Inc., New York. 1964.

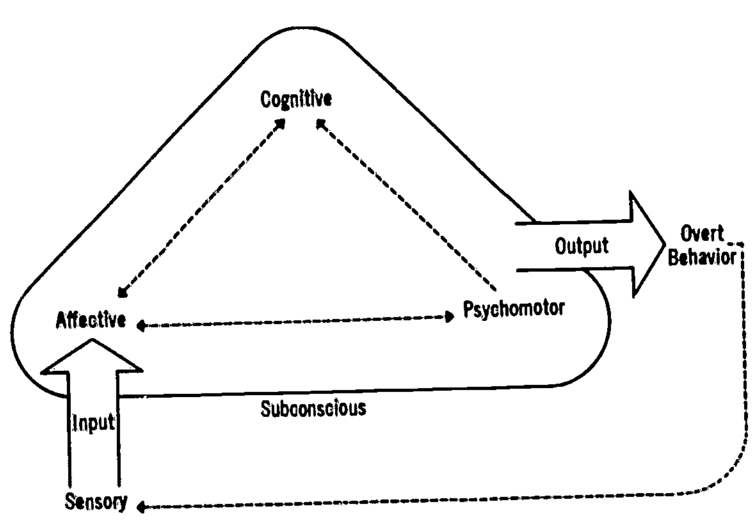
[2] *Ibid. Handbook II.*

At the present state of our knowledge about the affective domain, it may not be possible to suggest behaviors that invariably will serve as indicators of the achievement of a given affective objective, or to provide numerical values between overt behaviors and desired goals. Of course, this is true to a lesser extent with the cognitive domain. It is only in the psychomotor that the "credibility gap" is fairly closed between behavior and objective.

As it is used here, the "credibility gap" refers to the fact that evaluation consists of identifying some overt student behavior that will be accepted as evidence that the desired objective has been achieved. For objectives that are primarily psychomotor, the student may be asked to demonstrate that he can perform some task requiring the desired skill. For objectives that are primarily cognitive, the student may be asked to select the correct response from a set of possible responses. If the correct response is selected, the evaluator assumes that the desired objective has been achieved. With cognitive objectives there is less certainty that a given behavior is evidence of achievement of the desired objective than there is with psychomotor objectives. This lack of certainty is called the "credibility gap." It is surprising that educators who have become accustomed to the "credibility gap" in the cognitive domain should find it so difficult to recognize the even wider gap in the affective domain.

A Model for Learning

In order to understand the interaction of these three domains more thoroughly, it might be desirable to develop a learning model that will include them. One working model that has been effective in showing the relationships among the domains is shown below.[3]



[3]Eiss, Albert F. *Instructional Systems.* Experimental Edition. 1968. p. 25.

The base line in this model represents the barrier that exists between the subconscious and the conscious. Until a stimulus penetrates this barrier, which is called the LEVEL OF AWARENESS, the conscious mind is not involved with the stimulus. Once this barrier is breached and the mind becomes conscious of the stimulus, cognitive activity occurs during which the individual decides whether or not the stimulus is of interest. In the learning process, this represents a very critical period. If the individual decides that he is not interested in further exploration of the stimulus, he "turns it off," and his conscious mind turns to other, more interesting matters.

The decision made by the individual that he is interested in further exploration of the stimulus prompts the individual to make a value judgment. The behavior that results from this decision is often called CURIOSITY. It is a "tell me more" type of reaction. If the individual continues to give attention to the stimulus, curiosity eventually becomes interest.

While this mental activity is going on, conscious or perhaps unconscious, psychomotor responses are occurring. The interaction of the three aspects of the consciousness is called THINKING. During this interplay, if new information is stored in the individual's "memory bank," we say that learning has taken place.

It is probable that this process does not occur in the same way with every individual, or even with the same individual at different times. It would be a great mistake to build a learning model that did not allow for the infinite number of variations that may occur in the learning process. The danger of trying to build a rigid model, based on "either-or" decisions, is that many mental processes are more realistically placed on a continuum, rather than being categorized in an arbitrary fashion.

This is particularly true with attempts to explain the workings of the conscious mind or to categorize learning objectives. The thinking process involves all three aspects of the conscious to some extent, although it is possible that the psychomotor activity may not always be overt—that is, it may not be observable by another individual. However, until the psychomotor produces an overt activity that may be observed by others, there is no way of determining whether or not learning has taken place.

The Need for Behavioral Objectives

The necessity for evaluating the extent to which learning occurs involves a very important principle related to the learning process. Regardless of the way in which an objective has been stated, there is no way of determining whether or not it has been achieved until there is an observable, overt behavior on the part of the learner. This behavior may consist of a simple response (a smile, a nod of the head), or it may consist of a very complicated

psychomotor response, like writing an essay or making a speech. Without some concrete evidence, there is no way of knowing whether or not learning has taken place. More recently, however, many curriculum designers have decided that it might be more effective to identify the behaviors that provide clues to the success of the learning strategy, rather than leaving the behaviors undefined and in the "guesswork" stage.

The practical way of specifying the overt behaviors that will be accepted as evidence that learning has taken place is to express the objective in behavioral terms. Sometimes these are called behavioral outcomes. This practice has been gaining popularity with educators, but with wider use and more careful analysis some dangers have become evident.

The writers engaged in formulating the objective use hours of time and considerable "soul searching" in trying to be specific. Terms must be defined carefully, and statements must be clarified until each objective will be clearly understood by all who are involved. This is no easy task. Many behavioral objectives that come out of such attempts appear to be trivial and do not represent what the teacher is trying to achieve. Moreover, the ever-present "credibility gap" often raises questions about the validity of the behaviors that have been selected. The reason for some of the difficulties becomes apparent with a study of the history of behavioral objectives.

The term was first used by behavioral psychologists who developed their learning theories by studying methods of operant conditioning of animals, including pigeons and rats. Here, the terminal behavior itself becomes the goal for the learning process, and successful achievement of the behavior is concrete evidence that the learning objective has been attained. The principles that were established were then adapted to training human beings for specific tasks in which the goal of the learning strategy was attaining the terminal behavior. Here, again, the process was eminently successful. This success led to the definitions of a "closed-loop" learning sequence with provision for recycling the individual if learning did not take place during the first encounter with the learning strategy.

Frequently, the learning sequence is quite rigidly established. First, the programer is asked to specify clearly the behavioral outcome desired. Second, he is told to break down the learning sequence into small steps that could be arranged in logical order to lead to the desired outcome. Third, he will start the learner in the process with provision for "looping back" if any step in the learning sequence is not achieved. With Skinnerian theory,[4] each step is so thoroughly tested and so minutely fragmented that errors seldom occur and "looping back" is seldom, if ever, needed. Finally, a test—usually called a criterion test—is given, at which time the individual is asked to perform the

[4]Skinner, B. F. *The Technology of Teaching.* Appleton-Century-Crofts, Inc., New York. 1968. pp. 59-91.

stated behavior as evidence that the objective was attained. The criterion test item, therefore, is simply a directive to the learner to demonstrate the performance of the specified behavior.

This learning sequence has been used very successfully in training programs in which "closed-loop" instruction is possible. The process has been adapted to education for such activities as "drill exercises" and training individuals to operate machines, repair equipment, or perform other specific tasks.

In education, there is a limit to the number of activities that fit into this mold. Children can be trained to read, to add, to multiply, to operate a slide rule, or to repeat any number of specific facts that can be identified in advance. These are performance activities, and behavioral objectives can be written easily for them. Also, many activities of this type are taught in the elementary grades and in vocational education courses, which may explain why much of the activity in writing educational objectives in behavioral terms and programing learning materials has been in these areas of instruction.

But what about the more sophisticated goals of education: to develop the ability to think and reason, to encourage more creativity, to understand relationships, and to make valid judgments of the consistency or desirability of given plans for action? With these goals, the desired outcome depends upon the specific situation and may be as varied as the infinite number of situations that may be described and the infinite number of thought sequences that may occur in the human mind. It becomes evident that a "closed-loop" sequence of learning steps will not lead to the attainment of goals of this type. Does this mean that the use of behavioral objectives must be confined to training sequences, or is it possible to write "open-ended" behavioral objectives in which a *type* of desired behavior is described, rather than insisting on a specific behavior for which a training sequence can be designed? The answer to this question will determine the usefulness of behavioral objectives in education.

Perhaps it would clarify the problem if examples of "closed-loop" and "open-loop" objectives were given. Examples of "closed-loop" objectives are:

> At the conclusion of the instruction, the student will be able to add any column of ten three-digit numbers with ninety-five percent accuracy. Or: At the conclusion of the instruction, the student will be able to use a slide rule to multiply, divide, square, and determine the square root of numbers with a ninety percent accuracy.

In the above examples, a great number of specific examples can be used as criterion test items but they are restricted to a narrow range of possible types.

An "open-loop" objective would not be as precise and, therefore, not as restrictive. An example of such an objective might be:

> "Given a description of a situation in which a technological advance has created problems affecting society, the individual can identify the problems involved and the scientific principles that are related to the problems and will suggest a plan for solving the problems that were identified.

In this type of objective, a great many varied examples can be suggested with widely varying degrees of sophistication. It would be impossible to list all of them. Unless there is some further definition of the type of problem that is desired, the objective may be ambiguous and consequently not very useful. Frequently, this disadvantage can be eliminated by giving an example of the type of problem that is intended, for example:

> The student will be able to define the ecological problems caused by the use of DDT to kill insects over a wide geographical area, and suggest ways of eliminating or minimizing them.

The use of this problem as an example does not limit the choice of many other examples, and neither does it leave the objective so vague as to be of little value.

The reason for dealing at some length with the problem of writing "open-ended" behavioral objectives is twofold. First, the usefulness of specific behavioral objectives that are restricted and training-oriented is limited in education. Second, the way must be paved for the study of behavioral objectives in the affective domain, where they must be much more open-ended than is usually the case in the cognitive domain.

CHAPTER II | The Affective Domain

Categories in the Affective Domain

Krathwohl lists five categories of educational objectives in the affective domain: Receiving, Responding, Valuing, Organization of Values, and Characterization by a Value or a Value Complex. Most of the instruction in our schools is built upon the first two of the five categories; without the two, no educational system can be developed.

It was pointed out in Chapter I that no learning could take place in an individual until he became aware of the stimulus. This is the lowest level listed by Krathwohl in his analysis of the affective domain, but it is not necessarily the level at which effective learning will take place.

It is becoming increasingly apparent that the third level, that of values, has played a greater part in the learning process than most educators have been willing to admit. There is increasing evidence that the lack of attention to this category has resulted in many inadequacies in our present educational system. For example, there is evidence that increased awareness of facts of science often produces a dislike for science in many students, with the result that students avoid further learning situations.

Values and Value Systems

Maturing individuals, particularly in their adolescent years, develop a value system that often remains unchanged even when they become adults. Sometimes the values they adopt result in their failure to become productive units in society.

It may be argued that each individual has the right to develop his own set of values and to live by them. It may be argued equally well that individuals who have values far removed from the effective norms of society often become harmful to society or, at best, useless members of the group. In biology, parasites serve only their own ends and, as a result, have an adverse effect on the host organism. We must decide whether or not we need such parasitic organisms in our social group.

Every individual has a set of values by which he makes decisions. Often, these values exist in his subconscious, or are poorly defined. One useful goal

of education should be to assist the individual in identifying and examining his values and to change them if he decides other values would be more desirable and more useful to him, as long as those values do not infringe on the rights of others.

Developing Values

How do students develop values, and what values should they choose? Before getting involved with questions of moral judgments and debatable situations, let's begin with some of the more widely accepted values and leave decisions concerning the others until experience has been gained in dealing with less controversial ones. Open-mindedness, tolerance (within limits), curiosity, the ability to make value judgments, the desirability of scientific methods and experimentation represent values that most educators will agree upon. So, let's begin to think about encouraging students to develop these and leave more debatable decisions until later. How may these values be developed? Probably the best technique is to give students the opportunity to understand the importance of values and to make tentative decisions concerning them.

Class discussion is an excellent way to develop a sense of values. Often the teacher does not have to point out the "good" and "bad" aspects of the arguments given. If the students have the opportunity, they will do this for each other and develop their own values in the process.

The teacher's personal example is also an excellent means of developing a sense of values in students. Often, what the teacher *does* speaks much louder than what he *says*. Is the teacher open-minded? Is he willing to listen to others and give valid reasons for his decisions? Perhaps the teacher's use of a good set of values is the most effective way of developing them in the students.

Provide information about alternatives. Value judgments involve reflection and reason. Unless the students have the necessary knowledge for making decisions and have an awareness of the consequence, it is impossible for them to react on more than an instinctive basis or in the light of their acquired biases. Education consists in a large part in providing the student with the necessary basis for making such value judgments. They need more than this information; they need the opportunity to practice making such decisions.

Have tolerance of others' views. Occasionally, the teacher is the most prejudiced person in the classroom. Scientists sometimes show prejudice when evaluating the work of other scientists. Physicists may think poorly of biologists, and biologists of teachers, and teachers may think both groups are narrow specialists. Until we can demonstrate that we are able to think and act with tolerance toward others, we cannot expect to develop good value systems in our students.

All this points to the most important and the most neglected aspect of education: the development of a sense of values in the students and the improvment of their ability to make value judgments. The educational system cannot claim to be successful until affective goals have taken their rightful place in the classroom, as well as in the courses of study that provide the basis for instruction.

Attitudes, Interests, and Motivation

It was pointed out at the beginning of this chapter that no learning can take place without the awareness of an external stimulus to initiate the learning cycle. Krathwohl has suggested that interest begins with awareness and may extend to much higher categories in the affective domain.

Perhaps interest begins with curiosity and becomes interest when the individual's sense of values leads his conscious mind to explore the stimulus in greater detail and to seek for other stimuli to assist in the learning process. However, the individual's sense of values determines when the conscious has explored the stimuli to the desired extent and "interest lags."

The process of keeping interest alive so that continued learning will take place is called *motivation*. This is related to attitudes which range from willingness to respond to the subcategory of the development of value systems. Because the terms motivation, interests, and attitudes are so broad in their meaning, it is desirable to use more specific terms when describing the various categories in the affective domain.

The Affective Domain and Learning

The affective domain is central to every part of the learning and evaluation process. It begins with the threshold of consciousness, where awareness of the stimulus initiates the learning process. It provides the threshold for evaluation, where willingness to respond is the basis for psychomotor responses, without which no evaluation of the learning process can take place. It includes values and value systems that provide the basis for continued learning and for most of an individual's overt behaviors. It provides the bridge between the stimulus and the cognitive and the psychomotor aspects of an individual's personality. Why, then, has so little effort been made to assess student progress in the affective domain?

One reason for the lack of emphasis on teaching values in school is that the home and church have traditionally been the places where these were taught. Perhaps another reason for the neglect of affective goals has been the emphasis on the cognitive aspects of education. Traditionally, courses of study have begun with a brief statement of objectives in which "lip service" was given to the need for motivation and interest. Attitudes of students are

often mentioned in such statements. The emphasis on the affective domain usually ends here. The remainder of the course description deals with the concepts and principles to be taught, the facts to be learned, and the techniques for teaching them.

Perhaps one reason that teachers feel more comfortable when dealing with facts and principles is that this is the way in which they, themselves, were instructed, and they are not aware of other possibilities. Perhaps another reason is that it is easier to evaluate the outcomes of cognitive goals than it is to measure the outcomes of affective goals. Perhaps it is because the cognitive goals are more traditional and have been more clearly defined. Also, values are delicate, personal, and controversial, and teachers may hesitate to deal with these goals. Whatever the reasons, the fact remains that little attention has been given to the attainment and evaluation of the outcomes of affective goals in education.

Probably a major factor in the failure to give adequate emphasis to affective goals is the difficulty of testing for their attainment. Ministers, parents, and teachers are all aware of the gap that exists between what an individual knows he should do and what he does. Most of our techniques of evaluation lend themselves to an evaluation of what an individual knows. In the affective domain, what an individual knows may bear little relationship to what he does. This has led some educators to the conclusion that it is impossible to describe behaviors that would indicate the attainment of affective goals.

The problem of describing behaviors to indicate that affective goals have been attained became the theme for the aforementioned series of conferences sponsored by the National Science Supervisors Association during the 1967-68 school year. Some of the outcomes of these conferences, together with added activities in this field, are reflected in the following chapter.

CHAPTER III | Indicator Behaviors for Affective Goals

The "Credibility Gap"

The only way of evaluating the attainment of a learning outcome is to observe some overt behavior in the individual. As was explained in Chapter I, there is always a "credibility gap" between the desired objective and the observed behavior. This term describes the gap that exists between the objective that is given and the student behavior that will be accepted as evidence that the objective has been achieved. This is discussed in greater detail in *Instructional Systems.*[1]

In the affective domain, this gap is often very wide, and a given behavior may indicate the attainment of any one of several objectives, depending upon the thinking and motives of the individual exhibiting the behavior. Another difficulty is the operant conditions that we have developed in our students. If they are aware of the behavior desired by the teacher, it will often be produced on demand—the behavior itself will become the goal and not an indication of the attainment of the goal.

This is in contrast to the effectiveness of giving students a set of desired behavioral objectives in the cognitive domain. Once the student is aware of the specific behaviors desired, he will usually strive to attain them. Frequently, the failure to learn is not because the individual isn't capable of learning or doesn't want to learn, but merely that the objectives of the learning situation are so indefinite that he doesn't know what the instructor wants him to learn. When this occurs, he often becomes frustrated and stops trying. In many classes, the only way the student has of knowing what the instructor's objectives for him are is to examine the tests that the instructor gives. Not until evaluation time does the student discover what the objectives were.

But announcing the objectives in behavioral terms in advance will not work in the affective domain. Because of the individual's operant conditioning, he will show almost any desired behavior in order to win the approval of the teacher and/or to get good grades. An obvious solution to this dilemma is to observe the student in unstructured situations where he is not

[1]Eiss, Albert F. *Instructional Systems.* Experimental Edition. Part VI. National Science Teachers Association, Washington, D.C. 1968. pp. 62-68.

under any obligation to give the desired response. This is why it may be unwise to give the student a precise set of the behavioral goals in the affective domain that are to be used for evaluating outcomes. However, this does not mean that evaluation in the affective domain should be either incidental or neglected entirely. But it does mean that evaluation methods other than tests need to be found for evaluating outcomes related to many aspects of the affective domain.

Analysis of Categories in the Affective Domain

In his analysis of the affective domain, Krathwohl identified five categories:

1. Receiving, including awareness, willingness to receive, and controlled or selected attention.
2. Responding, including acquiescence in responding, willingness to respond, and satisfaction in response.
3. Valuing, including acceptance of a value, preference for a value, and commitment.
4. Organization, including conceptualization of a value and organization of a value system.
5. Characterization by a value complex, which provides internal consistency to the individual's value system.

A detailed analysis of these subcategories may be found in Appendix A of Krathwohl's book. [2]

Examples of Affective Behaviors

Willingness to respond is the lowest category in the affective domain that can be evaluated. Student response is often "on command," that is, the student responds when called upon or when given a specific task to perform. But willingness to respond does not necessarily imply that the student possesses a value that prompted the response. Perhaps it shows that the value was a desire for a good grade.

The next subcategory in the taxonomy is that of preference for a value. It is here that we need to look for indicator behaviors to show attainment of this goal. This goes beyond willingness to respond and usually must imply

[2]Krathwohl, David R.; Bloom, Benjamin, S.; and Masia, Bertram B. *Taxonomy of Educational Objectives. Handbook II: Affective Domain.* David McKay Company, Inc., New York. 1964. pp. 176-185.

some student-initiated activity. Some of the behaviors related to preferences for a value may be relatively simple activities, like the examples given below:

The student asks to assist in the laboratory or stockroom. The student may first show this value by just "hanging around" in free periods or after school and, later, this may develop into a regular practice. Of course, if the student is paid for assisting, the behavior ceases to be as useful as indication of his preference for a value of science; it may be that he values the pay enough to perform an unpleasant task.

The student volunteers to do extra classwork. He may offer to read a book or write a report on some topic in which he becomes interested. Of course, there is always the possibility that such an offer is just to "butter up" the teacher in order to get a better grade, but students usually don't go to very great effort if this is their prime motive.

Another indicator behavior of preference for a value is participation in club activities. Of course, there is always the possibility that participation is linked to the student's friend who has joined, providing the opportunity for a pleasant social contact. Such a reason would probably be apparent to an observing teacher. If the student takes an active part in club planning and operation, this would be a still better indicator behavior of his value for science.

Still another behavior may be found in his discussions with his parents and his peers. When a parent says, "Johnny is always talking about science at home," this provides excellent evidence that he "values" the subject.

Commitment to a Value

Preference for a value and commitment to a value are points on a continuum of values. Some indicator behaviors that might show stronger commitment than those above include:

A student argues with his peers for a point of view involving values. Most students hesitate to disagree with their peers unless they are just "arguing for fun" or really hold a value firmly enough to stand up and defend it. Another related behavior is displayed when the student attempts to influence others to take a specific line of action. For example, students who pick up papers around the school yard and encourage others to do so indicate that they are committed to values related to cleanliness and order, at the risk of being classified as "a square."

Sustained interest is a good indicator of commitment to a value. When a student carries out a research project "on his own," or does extensive library research on a topic not specifically related to a school assignment, he shows commitment to his values.

Action Verbs

The above examples are only a few of many behaviors that may indicate attainment of affective objectives. However, it is not sufficient to wait for the student to exhibit a behavior that may be related to the attainment of an

objective in the affective domain. It will be necessary to select the behaviors that are desired and to provide opportunities for the student to exhibit them. And it will be necessary to determine regularly whether success is being attained in getting the student to exhibit the selected behaviors. Only then will acceptable evidence be had of the extent to which desired results are being achieved.

Each teacher should build a list of such behaviors to provide a basis for evaluating the attainment of affective goals and continue to expand or revise the list from time to time. To assist in this process, the list of action verbs given below may provide some clues for writing further behavioral objectives and will lead to the identification of desirable behaviors that students should exhibit.

ACTION VERBS WITH PARTICULAR VALUE FOR THE AFFECTIVE DOMAIN

selects	objects (to an idea)	proposes	suggests
chooses	adopts	rejects	supports
participates	submits	accepts	recommends
challenges	perseveres	consults	shares
attempts	praises	questions	disputes
seeks	defends	queries	subscribes
persists	obeys	weighs (judges)	promotes
asks	keeps (preserves)	criticizes	spends (money)
joins	investigates	evaluates	annotates
gathers (information)	attempts	tests	advocates
organizes	tries	delays (response)	volunteers
visits	specifies	qualifies	sleeps
argues (a position)	offers	designs	yawns

The Importance of Individual Differences

Students are individuals. We do not want them cast in the same mold, but we want to develop their individual potential to the fullest extent. All students are not equally enthusiastic about science, nor do we want them to be. How unfortunate it would be if everyone wanted a career in a science-related field! However, as adults in a technological age, we will be surrounded by a scientific and technological environment, and we need to develop enough knowledge and interest in it not only to survive but to become useful members of our society.

This means that every individual should possess a minimum acceptance of values related to science, as well as some of the general concepts and ideas concerning it. But every individual will not show his value judgments through the same overt behaviors. This implies that every student should show *some* behaviors that will indicate his attitude toward science, but that *no* student will be expected to show *all* of the behaviors that are identified.

At least, student attitudes toward science should range from acceptance of related values toward the more positive side of the domain. It would not be desirable to inculcate negative values–something that frequently occurs as a result of some science courses. To be opposed to science is to oppose learning itself. The applications of scientific discoveries may be harmful, but that is the fault of men and not of the knowledge of science or the process itself.

It is the responsibility of the teacher to identify the desirable behavior patterns that he wishes to develop in his students and work toward those objectives. He must chart a middle course between expecting every student to become a potential scientist and the other extreme of teaching all his students to hate science. There is plenty of room for the variation of individual differences on the positive side of the ledger.

CHAPTER IV | Evaluating Affective Outcomes

Evaluation Instruments

Evaluation may serve two useful purposes—evaluation of student achievement and evaluation of the effectiveness of the instructional program. These purposes are interdependent. Sometimes it has been assumed that satisfactory student achievement is sufficient evidence of the adequacy of the instructional program. But this assumption is not necessarily true. There is considerable evidence that our present instructional system is clumsy and inefficient and would benefit from a careful analysis and thorough overhaul. This observation may have considerable implication for the need for evaluating the effect of the instructional system on affective outcomes.

Statistics show that about two elementary students in every hundred become science majors in college, and slightly more than two others minor in science.[1] Teachers have been prone to accept a show of interest on the part of these "science-prone" students as evidence that the instructional program was functioning smoothly. But is this necessarily true? Probably these students, who are highly motivated in science, would continue to learn regardless of the quality of instruction.

But what about the 95 percent of the students who are not as highly motivated? In a recent article, Bloom[2] suggests that perhaps the bottom 10 percent cannot be properly educated in our present school system, but that the remaining 90 percent can, and should, learn. In order to learn science, they must possess a set of related values that is strong enough to provide the necessary interest and motivation.

How can the adequacy of this level of motivation be assessed? There are many ways of evaluating outcomes. Here are a few suggestions.

TYPES OF EVALUATION INSTRUMENTS

1. Personal discussion and interviews
2. Performance tests
3. Individual inventories

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[1] Data adapted from *American Education*, Dec. 1967-Jan. 1968, and from *The World Almanac*, 1968.

[2] Bloom, Benjamin S. "Learning for Mastery." *UCLA Evaluation Comment* Vol. 1, No. 2; May 1968. (CSEIP Bulletin).

4. Student reports or term papers
5. Rating scales
6. Subjective test questions
7. "Objective" test questions
8. Check lists

Most of the eight items listed can be used in evaluating affective objectives. Suggestions for using some of these are given below, and examples of evaluation items appear in the appendix of this monograph.

1. *Personal discussion and interviews.* This technique is an excellent way of determining the student's attitudes and values, particularly if indirect questioning is used. Direct questions like "How well do you like science?" or "Why do you think science is important?" will usually result in an answer designed to give the investigator the answer that the student thinks is wanted. A few questions that might be included in an interview to identify the student's values are suggested below.
   a. What subjects do you like most?
   b. What do you do in your spare time?
   c. What hobbies do you have?
   d. Do you like to visit museums?
   e. Would you like to visit a research laboratory?
   f. Have you made a career choice? What is it?
   g. Would you like to meet a scientist? What do you think he will be like?
   h. What do you like (and dislike) about science?
   i. Has anything in your science class(es) been useful in your everyday living?

These questions may stimulate one to think of other, more effective questions that may be used in personal interviews to assist in evaluating the students' values related to science.

2. *Performance tests.* These will be of little help in identifying student values, because performance implies a "command" situation where the individual is demonstrating his ability to perform a certain act and does not show his attitude toward the action. However, one could use a test in which the student reveals a value or attitude through his choice of a way to carry out a certain procedure.

3. *Individual inventories.* In this type of instrument, the student is asked to check his preference for, or attitude toward, certain ideas or activities.

4. *Student reports or term papers.* These are useful in two respects. A term paper assigned on a science topic may show the student's values in the stand he takes for or against positions that may be discussed in the paper. Of course, if the report is merely a dry recital of facts gleaned from source books and encyclopedias, the report is probably of little value to the

student in any respect. However, such a report in itself may indicate a total lack of interest in science and should motivate the instructor to try to develop an instructional program that will be more meaningful to the students.

Another way in which a term paper may show students' interests or values may be through the selection of a science-related topic for a term paper or a report in another field; for example, social studies or English. Teachers in other subject areas should be encouraged to "pass along" such papers for the science teacher to read, because the contents of these papers may reflect the individual student's interest in science and his values related to science more than does a paper assigned in the science class.

5. *Rating scales.* These instruments may be useful to show the extent to which the student likes science, as well as provide some indication of the values he holds. Rating scales are built upon two opposing words or ideas, spaced along a continuum. The student is asked to place a mark along the continuum to show how he feels about the terms. A few sample items are shown below:[3]

SCIENCE IS

whee!	yetch!
theoretical	practical
inconvenient	convenient
complex	simple
wide	narrow
easy	troublesome
unnecessary	basic
dull	emotional
efficient	inefficient
universal	limited
outgoing	ingrown
broadly interpretive	dogmatic
imaginative	unimaginative
interesting	uninteresting
objective	subjective
clear	fuzzy
useful	harmful
good	bad
exciting	boring

6. *Subjective test questions.* These provide the best opportunity to get students to show their values related to science and to demonstrate their

[3]These word pairs were suggested by a student at the junior level in high school.

ability to show good judgment in making decisions concerning important problems. It must be remembered that if students are taught specific values or ideas in an authoritarian fashion, they will reflect the instructor's thinking when answering related questions. In order to get students to show their own values and biases, it is necessary to choose a topic that has not been discussed in class or about which no value judgments have been made in class. Otherwise, the answer may reflect the lowest level of response—the ability of the student to repeat what he has been told.

The best examples of the type of question requiring the exercise of value judgments will present two conflicting situations, neither of which is obviously good or bad, asking the student to make a choice and give a reason for the decision he has made. With a question of this type, the student should not be graded on the choice he makes, but on the reasons he gives for making that particular decision. The two questions below illustrate the type of question that might be used.

a. The town council has been caught in a budget squeeze between the need for a new sewage disposal system for your community and the need for improved medical services at the local hospital. You have been invited as a citizen to visit a council meeting and make recommendations for action. What would you recommend and what reasons would you give to support your decision?
b. Suppose that the science club, of which you are a member, is planning its year's activities. What activities would you suggest for the club and what reasons would you give to encourage others to support your selection?

Of course, questions of this type must be adapted to the particular needs of the individual, the school, and the community. The important thing is to get the student to show his values in the reasons he gives for his decisions. It is important that the student get credit for any reasonable answer—the quality of the reason often being more significant than the position taken.

7. *"Objective" test questions.* Objective test questions have their subjective aspects and possess many of the same weaknesses as subjective questions.[4] Questions like the ones suggested in Item 6 can be made quick scoring by providing sets of possible answers that would accurately reflect the sort of choice that the student might be expected to make and permit him to check the response of his choice. Such a question is, of necessity, less open-ended than an essay-type question but does have the advantage of being quickly scored.

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[4] Eiss, Albert F. *Instructional Systems,* Preliminary Edition. 1968 Overhead No. 39. p. VII-2.

If you wish to permit a little more leeway in the question, it is possible to leave a blank for some other answer. In this case, you would have to read only those answers that the student wrote in because he didn't like any of the responses you had included.

8. *Check lists.* These are very useful instruments, lying between subjective and "objective" type questions. Such lists can be used to identify student's preferences for types of activities, his estimates of the effectiveness of the instructional program, his likes and dislikes in science, and his suggestions for improving the instructional program. If the responses are weighted with a value of from one to five instead of provided merely for checking, a more quantitative response can sometimes be obtained. An example of a check list is given in Appendix B.

Developing an Evaluation Program

What are the major steps in developing an evaluation program? Can a logical plan of action be prepared in advance, or must it be developed during the evaluation process? Probably the answer to both of the above questions is affirmative. A good plan needs to be prepared in advance, but it will surely have to be adapted to the task once data begin to accumulate.

The first step in improving instruction is the evaluation of the existing program. What are its strengths and weaknesses? What needed changes are indicated? The next step is to develop a plan of action to institute the needed changes. This plan should provide plenty of opportunity for feedback, because the lack of an opportunity for feedback is one of the major complaints of students. It is important to remember that evaluation is a continuing process, and a good course of instruction provides plenty of opportunity for feedback and change.

Suggestions for an Evaluation Program

Considerations in developing an evaluation program:

1. A good program evolves; it is not created. Provide plenty of opportunity for revision and change as you proceed.
2. Use a variety of evaluation instruments. No single method of observing affective behaviors will be adequate.
3. Allow for individual differences. Too often teachers try to force all their students into a single mold. There is need for some uniformity, but there is equal need for variety of response.
4. Trends are more important than absolute attainments. Look for trends and encourage students who show favorable changes.

5. Be honest and open-minded. Students are very sensitive to teacher attitudes and will not be honest unless the teacher is honest with them. Probably the students won't believe it at first if the teacher tells them that he wants them to make suggestions for improving the course in order to make it more interesting. He will have to convince them that he is sincere.
6. Be prepared for change. If a teacher is honest, he may be unprepared for the amount of change that is indicated. Does he really mean it when he says that he wants the students to like science? If he finds they don't, will he be willing to revolutionize his teaching techniques to make it more acceptable to the students? Is he capable of the change in thinking and action patterns that may be necessary in order to accomplish this?
7. Look for leaders. Leaders are found in almost every class. They are key individuals who influence the others profoundly. If they are on the teacher's side, he will have a valuable source of information as well as a means of influencing the others in the class. He may use them on teacher-pupil planning committees.
8. Experiment with new ideas. Experiments don't always succeed, so be prepared for failures. Don't let yourself become discouraged by failures, but try different approaches until you find one that works.
9. Keep the project open-ended. Improvement of teaching is never finished. Changes will always be needed, so don't lock the teaching program into a rigid pattern.
10. Try taping a class session, either with a sound tape recorder or a video-tape. Analyze the tape to see if the lesson was teacher-centered or student-centered. Ask such questions as:
    a. What percent of the time was the teacher talking?
    b. To what extent did students have the opportunity to discuss their problems and ideas?
    c. How often was theory presented as fact?
    d. How many student suggestions or ideas were received and acted upon?
    e. How authoritarian was the teacher?
    f. Is the atmosphere in the classroom conducive to the free exchange of ideas?
    g. Who held the center of attention? Who contributed most of the ideas presented?

Identifying Weaknesses in the Program

In analyzing and evaluating the program, there are some weaknesses that will appear. Some of the weaknesses that have occurred with other teachers are listed below, to assist in the evaluation and to prepare plans for changing the program.

FACTORS THAT OFTEN CAUSE STUDENTS TO LOSE INTEREST IN SCIENCE

1. Excessive amounts of material discourage the student. If only the "best" students (usually meaning those who memorize easiest) can "cover the work" that is assigned, the result is usually an unhappy class that will lose interest rapidly.
2. The material is presented in an uninteresting manner. Students often get tired of hearing teachers talk. How many minutes of the class time are spent in "telling" the students? Borrow a stopwatch from the coach and see for yourself. Do the students appear to enjoy their classes, or do they come into them in a listless fashion?
3. The vocabulary or reading level of the material may be too difficult. Some instructors never use a simple word if a difficult one is available. This may impress strangers, but it "turns off" the students.
4. The contents of the course may be unrelated to the students' interests and everyday lives. Science, of all subjects, can be related to every aspect of an individual's daily life. Failure to make this relationship clear often accounts for the lack of interest in science classes.
5. The class is paced too fast to allow for reflective thinking. As a result, assignments become a sequence of memorization exercises (see Item 1). A few topics, carefully investigated, may be more valuable to the student than a "run through" of many.
6. Student's difficulties are not diagnosed and corrected early enough to insure his continued progress. Such items as 1, 3, and 4 may be related to this problem.
7. There is a lack of variety in the teaching techniques. A technique useful in one situation may not be satisfactory in another. The lecture method is perhaps the least interesting and least effective of all teaching techniques. Some students learn more efficiently by one method, and other students learn more efficiently by other techniques. The techniques used need to fit the personality "set" of the individual student.
8. Look for the teacher's personal idiosyncracies. Often some of these distract students from the work at hand. Perhaps a fellow teacher who is a real friend might be willing to point them out. Or, studying a video-tape of a class session may be helpful for this purpose.
9. Lack of personal involvement on the part of students. Learning is not a spectator sport; it will not occur until the individual himself becomes involved in some way. Does the teacher provide for this involvement in his instructional program?
10. Anxiety from worry about test results often overshadows any pleasure the student may find in class. Frequently, overemphasis on test grades is the

fault of parents as well as teachers and administrators. Are teachers and parents more interested in having students enjoy learning or in getting high grades? If "examination week" is a time of worry and anxiety, it is a sign that too much emphasis is being placed on tests, and that there is a weakness in the instructional system.

A Plan for Action

Are affective objectives emphasized enough in the course of study? Does something need to be done about it? Here are some suggestions that may be helpful.

Step 1. Preparation of evaluation instruments

Look in the appendix and bibliography for some ideas for evaluation instruments. Build a set that will (hopefully) provide the data that are needed. Perhaps it will be necessary to build or adapt some instruments personally. If so, be prepared to do a preliminary trial and revision of them before their full-scale use. These instruments should include, among others:

a. A personal inventory for the teacher
b. A check list for students (Provide an opportunity for students to list good as well as bad points of the program.)
c. A series of check lists for the teacher's use (These should include behavioral objectives for students in the affective domain which can be observed by the teacher.)

Step 2. Application of the check lists and analysis of results

This step should include interviews with students to discuss some of the results of the evaluation and to ask them for further suggestions for change.

Step 3. The experimental phase

Here, be prepared to face a real, pervasive situation. If it appears that one of the reasons for a lack of interest is that too much material is being presented for the time allocated, be prepared to reduce the amount of material in order to sustain interest. Otherwise, the evaluation is finished, and the old techniques of teaching will return. The school administrator may have a role to play in making this decision.

Step 4. Revision of evaluation instruments and re-use

The results from experimental use will indicate many of the revisions, additions, and deletions that are necessary.

Step 5. Return to Step 3 and begin with experimental efforts at revising your program; then to Step 4, and so on.

Values and Grades

If values are central to the educational system, what should be their place in the grading system? Should students receive grades for open-mindedness and tolerance? Should they be graded on the extent to which they use scientific methods in decision making in their everyday lives? Probably, it is impossible to give the student a grade for *interest* or *values*. Certainly, it is undesirable.

A qualitative score, however, might well be given for the achievement of behavioral goals in the affective domain, if the score is used as an indication of the success of the school in achieving its goals and of teachers in carrying out the instructional program. If a student fails in attaining an affective objective, it must be attributed to a failure on the part of the instructional system and the techniques of instruction, rather than to a failure on the part of the student. Perhaps this is why so few attempts have been made to evaluate the attainment of goals in the affective domain or to structure learning activities intended to accomplish these goals. The thought has occurred many times that, although cognitive learning may produce a trained person, it will not produce an educated one. It is necessary to continue the search for methods of inducing and measuring learning in the affective domain.

Appendices

APPENDIX A | Examples of Affective Goals in Behavioral Terms

Summary: Suggested Behaviors Denoting Scientific Literacy

(from "Summary Report NSSA-NSTA Workshops on Behavioral Objectives," issued in 1967)

At the Philadelphia regional meeting in 1967, each working group was presented with a set of statements and asked to identify specific overt behaviors which might be evident in scientifically literate citizens, to support the presence of the characteristics contained in the set of statements given them.

The capital-lettered categories, below, are based on those suggested by Bloom and Krathwohl.[1] The r·umbered statements were adapted from a list of ways suggested by Paul DeHart Hurd,[2] by which the scientifically literate person can be identified. The small-lettered statements are the expansions of these behaviors as formulated by the participants of the regional meeting at Philadelphia.

A. Awareness of conditions
   1. relates personal requisite abilities, interests, and attitudes
      a. participates in extra-curricular science clubs and fairs
      b. selects a science-related summer job
      c. given an attitude or ability check list, can relate himself to the list as to a possible career in science.
   2. appreciates the interaction of science and technology
      a. joins Junior Engineering Technical Society (JETS) or a rocket club
      b. gets a summer job in an industrial laboratory
      c. discusses social problems in terms of the relationship of science and technology, including automation
      d. willingness to support scientific endeavors because of eventual technological applications

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[1] *Op. cit.*, Handbooks I and II.
[2] From final report of the Second Working Committee on Conceptual Schemes of the National Science Teachers Association. 1968.

e. willingness to apply the scientific method to the solution of any problem
f. attempts to build equipment based on a learned concept

3. appreciates the interaction of science and the arts
   a. designs and carries out a science project which relates science to music or art
   b. composes music through computer programming
4. appreciates the limitations of science
   a. limits conclusions to present data but verbally recognizes possibility of error
   b. willingness to retest in the face of seemingly conclusive data
   c. frequently challenges classmates or teachers who make authoritative statements, such as "science has proved. . . ."
5. understands that science is generated by people with a compelling desire to understand the natural world
   a. shows interest in and respect for famous scientific biographies
   b. chooses a life vocation based on other than expected earning power
   c. selects a biography of a scientist to fulfill a book report requirement in another subject
   d. watches TV programs about scientists
   e. shows respect for the ideas of scientists
   f. recognizes that science is an enterprise of *human* beings
6. recognizes that science grows, possibly without limit (or: the processes of science lead to a never-ending quest for knowledge)
   a. realizes that controversies are inevitable in the process of growth
   b. evidences ability to live with change
   c. upon learning the results of a study, states additional possibilities to investigate
7. recognizes that the achievements of science and technology properly used are basic to the advancement of human welfare
   a. chooses a career of service in nursing, resource management, or other occupation utilizing science for human welfare
   b. supports taxes for community solution of pollution problems
   c. does not pollute air and streams, and practices conservation
   d. participates in mass inoculation programs
   e. supports public health agencies
   f. contributes to research
   g. has periodic physical and dental examinations
   h. volunteers services for community organizations
8. recognizes that the meaning of science depends as much on its inquiry process as on its conceptual patterns

a. defines science as both a process and a way of explaining phenomena
b. can select appropriate investigative strategies to the solution of a problem
c. can identify and state a problem

9. appreciates the cultural conditions under which the scientific enterprise is promoted
   a. accepts the concept that the social and economic climate will support or discourage the scientific enterprise
   b. gives logical arguments for or against national policies for the planning of research
   c. writes to congressmen urging support of legislation in favor of scientific research

B. Acceptance of values

10. rejection of myths and superstitions as explanations of natural phenomena
    a. analyzes superstitions to see if they have scientific relevancy
    b. collects data to determine degree of reliability of common superstitions

11. has the habit of considered response
    a. volunteers recitation only when he has an organized relevant response
    b. retains questioning attitude to permit adequate consideration of possible options, and to permit a conscious plan of attack, clearly looking forward to a prediction of the probable outcome or solution

12. has the habit of weighing evidence to formulate a considered response
    a. habitually consults more than one authority in searching for explanations
    b. identifies assumptions made as the basis of his decision-making and then questions their validity

13. realizes that science is a basic part of modern living (some participants thought this should be deleted)
    a. comments on pseudo science in advertising media
    b. when asked to comment on the conditions of modern living, cites technological and scientific advances which lengthen life, shorten work week, etc.
    c. accepts science as a human intellectual endeavor which contributes to our society

C. Preference for values

14. curiosity
    a. frequently asks questions and challenges statements of others
    b. asks different people the same question
    c. applies multi-resources to one question
    d. often takes a second look
    e. goes out of his way to find answers
    f. reads numerous books and magazines
    g. habitually examines the working parts of equipment being used
    h. visits museums and industrial or food-processing plants
    i. initiates questions voluntarily
    j. exhibits awareness of discrepancies in his environment
    k. collects and orders the collection in some way
    l. includes reading about science and watching science based programs in leisure time activities
    m. uses all senses in making observations
15. patience
    a. is willing to wait for something worthwhile, i.e., data
    b. undertakes long-term projects where no immediate results are possible
    c. is willing to perform time-consuming procedures without attempting questionable shortcuts
16. persistence
    a. is willing to repeat an effort voluntarily
    b. redesigns experimental systems in an attempt to improve results
17. open-mindedness
    a. listens carefully when others are talking
    b. insists on hearing more than one opinion on one piece of evidence
    c. is willing to change ideas when new or additional evidence is available
    d. will give consideration to ideas which differ from his own
18. confidence in the scientific method
    a. follows instructions of doctor
    b. cleans out medicine closet periodically
    c. attempts to use scientific methods when making decisions
    d. looks for data or evidence before acting
    e. consults and considers consumer reports
    f. votes for elected officials on the basis of available evidence
19. "the search for truth" (nothing reported)
20. the importance of science for understanding the modern world
    a. enrolls in science courses

21. intellectual satisfaction to be gained from pursuit of science
    a. engages in investigative activity during leisure time
    b. asks about and shares his observations of similarities and differences in his environment
22. the desire to be creative
    a. participates in research on his own initiative
    b. offers realistic alternatives to a suggested method for doing something
    c. gets involved in independent study
    d. displays a variety of reactions or insights
23. enjoys science for intellectual stimulus and the pleasure of knowing
    a. gravitates toward idea-exchanging activities

APPENDIX B | Examples of Evaluation Items in the Affective Domain

Test Items Based on Affective Domain Objectives

(from "Summary Report NSSA-NSTA Workshops on Behavioral Objectives," issued in 1967)

Some working groups at the regional meetings constructed test items to accompany specific objectives. In the samples that follow the objective being tested is stated first and is followed by the test items.

1. The objective is, "The student will demonstrate his ability to distinguish between causative and contributory data.

   Test Item: A boy goes ice skating on a cold, windy day, falls into a pond, is pulled out and given a drink of hot cocoa by someone who is sneezing. Two days later, he shows symptoms of a cold. What do you think was the cause of his cold?
   a. the boy was cold
   b. he got his feet wet
   c. the wind caused a draft
   d. he drank hot cocoa
   e. he was carrying a virus
   f. someone sneezed near him
   Which of the above may have been contributing factors? which of the above are not contributing factors?

2. The following test items are designed to measure the achievement of these three objectives:
   (1) Given a situation involving two alternatives, the student will formulate and defend a procedural method by which he arrives at his tentative decision.
   (2) The student, having made a decision, is presented additional evidence; he is then willing to reconsider and reformulate his decision.
   (3) Given a situation involving three variables, the student will formulate a response which is factually correct based upon experimental evidence.

   Test Item I: a. Recognizing a prevalent insect problem in a home garden enterprise, you have two possible courses of action aimed at control: (1) employ use of chemical insecticides, (2) employ use of biological control. You are aware of the fact that both means are available at about

equal cost. Choose a course of action and defend it.

b. You are presented with additional evidence as to chemical and biological controls. You will now support your original decision or communicate your reasons for modification.

Test Item II: a. In a farming – wildlife situation, what will be the results of killing off all the wolf population as compared to not killing any?

b. Reformulate your decision in light of this added information: The area is, in addition to wolves, populated with prairie dogs, hawks, reptiles, and elk. How will the extermination of the wolf affect the ever-changing balance of life in the area?

3. The following ten questions are designed to test this objective, "The student will show understanding of the symbiotic evolution of the scientific enterprise and the living standards of man."

Test Items a. When given a list of 10 scientific breakthroughs, he will be able to identify 5 that have changed world events and list at least one way in which each of the 5 selected has changed world events.

b. He can cite 5 specific instances where tradition has been of value and 5 other instances where tradition has been a factor limiting progress.

c. He questions but consults and respects authorities until he finds a more plausible explanation.

d. He speaks for and in defense of such issues as conservation of natural resources, control of air and water pollution, promotion of better education.

e. He donates time and money to efforts that tend to improve the lot of all mankind.

f. He can arrange at least 3 flow charts that explain the chain of events from raw materials to finished product.

g. He reads at least three articles each month that are concerned with science or science-related materials.

h. He attends at least 3 meetings and/or exhibits each year where the topic is concerned with science or science-related materials.

i. He belongs to at least one scientific society (better if he is active in it).

j. He encourages members of his own family to become professional scientists if the individual shows an interest in a scientific career.

Conditions: Minimum passing grade for meeting the objective is 5 "yes" out of ten.

APPENDIX C | Examples of Evaluation Instruments

1. Course Evaluation and Attitude Scale

(Excerpts from an evaluation rating instrument that includes information about attitudes, value judgments, and other affective goals.)

NOVA SCOTIA SUMMER SESSION[1]
FINAL EXAMINATION PART II
COURSE EVALUATION

August 1968

Name____________________

Course Number________________

What will be your duties during the coming year? What subject or grades do you plan to teach?

Indicate how much you agree or disagree with each of the statements below by placing a check in the space corresponding to the letter representing one of the following expressions:

Strongly disagree (SD); Disagree (D);
Neither agree nor disagree (N); Agree (A); Strongly agree (SA)

	SD	D	N	A	SA
1. Evaluation plays a critical role in educational improvement.	5	4	3	2	1
2. I think that I could identify types of decisions which need to be made in most science programs in which I might work.	5	4	3	2	1
3. The model of an instructional system, involving philosophy, goals, program, and outcomes, is a useful way to view the evaluation of science programs.	5	4	3	2	1
4. Analyzing objectives and tests using Bloom's TAXONOMY was a useful technique to identify needed program changes.	5	4	3	2	1
5. A knowledge of the structure of an instructional system is useful in attempting to design an evaluation program.	5	4	3	2	1

[1] Inservice training program for public school teachers and supervisors conducted by the Ministry of Education of the Province of Nova Scotia. The items were adapted from the report of the Institute on Evaluation of Science Programs, sponsored by NSTA and funded by the U.S. Office of Education.

	SD	D	N	A	SA
6. Many of the techniques suggested in the institute (definitions of scientific literacy, the affective domain, etc.) have little value for evaluating science programs.	5	4	3	2	1
7. The feedback during the work sessions was helpful to me in understanding the feedback process.	5	4	3	2	1
8. The theory behind Bloom's TAXONOMY is good, but unrealistic in real life.	5	4	3	2	1
9. Developing objectives makes me feel more confident in planning my teaching.	5	4	3	2	1
10. I feel a sense of insecurity when attempting to plan an evaluation program.	5	4	3	2	1
11. There are many factors in planning an evaluation program, and I feel lost when trying to deal with all of them.	5	4	3	2	1
12. Objective writing is something that I enjoy doing.	5	4	3	2	1
13. I think that Hurd's statement on scientific literacy is not an adequate description of what a scientifically literate citizen should be.	5	4	3	2	1
14. When I hear the word *objective*, I have a feeling of dislike.	5	4	3	2	1
15. Analyzing test items does not serve a useful purpose.	5	4	3	2	1
16. The development of program or educational objectives is a necessary procedure.	5	4	3	2	1
17. Beginning teachers are too inexperienced to learn to write objectives.	5	4	3	2	1
18. Writing test items is a very useful practice.	5	4	3	2	1
19. I think I have a positive reaction toward the ideas presented in this institute.	5	4	3	2	1
20. I become frustrated when I think about writing objectives.	5	4	3	2	1
21. I approach writing objectives with a feeling of hesitation resulting from a fear of not being skilled in writing them.	5	4	3	2	1
22. I could have learned as much by reading a book.	5	4	3	2	1
23. The instructor(s) really knew his (their) subject.	5	4	3	2	1
24. The daily schedules were too fixed.	5	4	3	2	1
25. Objective writing is very important to me.	5	4	3	2	1
26. The overhead-taped presentations were a waste of time.	5	4	3	2	1

The major topics which were presented in this course are listed below. Please respond to each topic by checking whether you think the time spent on it was too much, too little, or about right.

	Check One: Too Much	About Right	Too Little
1. Explaining the model of an instructional system	______	______	______
2. The nature of scientific literacy	______	______	______
3. Studying Bloom's TAXONOMY as a basis for classifying objectives and test items	______	______	______
4. Classification of objectives and test items	______	______	______
5. Learning what behavioral objectives are and why they are important	______	______	______
6. The difference between normative tests and criterion tests	______	______	______
7. Writing behavioral objectives in the cognitive domain	______	______	______
8. Writing objectives in the affective domain	______	______	______
9. Writing test items	______	______	______
10. Identifying student behaviors	______	______	______
11. Identifying teacher behaviors	______	______	______
12. Feedback from the instructor on identifying weaknesses in test items I have written	______	______	______
13. Planning my evaluation program for next year	______	______	______

2. A Check List for Evaluating Behaviors Related to Affective Goals

There is general agreement that there are many student behaviors related to the affective domain that are desirable, and there is agreement on many of the types of behaviors that are desired, but there has been little effort to see whether or not these behaviors are exhibited in a reasonable number of the students. Teachers spend hours and hours deriving precise numerical "grades" for cognitive behaviors, although such precision is probably unwarranted. On the other hand, many of these teachers attempt to evaluate the affective domain in the most haphazard fashion, if at all.

One possible solution to this problem is to develop a check list for evaluating the extent to which individual students show the desired behaviors, without attempting to provide numerical ratings or identify one-to-one relationships between behavior and affective goals.

No single student should be expected to exhibit each behavior, but each student might be expected to show evidence of one or more of the behaviors listed at reasonably frequent intervals. If a new list is used each month, it might be possible to compare a student's final month's performance with his performance earlier in the year.

HOW TO USE THE CHECK LIST:

Write the students' names or numbers at the top of the check list and the desired behaviors down the left-hand margin; check the appropriate behaviors beneath the student's name or number whenever he is observed exhibiting them. Also, you may wish to use minus signs to indicate "negative behaviors" that are observed, that is, when the student exhibits a behavior that is the opposite of what is desired. Additional behaviors may be added in the blanks at the bottom of the page.

Desired Behaviors **Students' Names or Numbers**

VERBAL BEHAVIORS

Argues:
- Advocates desirable actions
- Defends desirable actions
- Criticizes plans and suggestions

Asks:
- Inquires for further information
- Examines others' ideas by further questioning

Explains:
- What others have said
- Personal ideas
- Principles and theories
- Reports on a science topic

Reads:
- Science magazines
- Science books
- Science articles in the dail, or weekly press

NON-VERBAL BEHAVIORS

Participates:
- Joins science clubs
- Participates actively in science clubs

Contributes:
- Time to science projects
- Money to science projects
- Time and money to agencies attempting to improve man's environment

Purchases:
- Scientific reading materials
- Science equipment

Borrows:
- Science books
- Science equipment

Selects:
- Discriminates between useful materials and "gadgets"
- Signs up for advanced science courses
- A science-related career

Visits:
Science centers
Hospitals, health centers
Research laboratories

Assists:
In laboratory preparation and operation

Eats:
Nutritionally balanced meals

Repairs:
And adjusts science equipment

Builds:
Science-related equipment

Works:
Part-time in science-related job

(Other items should be added as needed.)

3. Inventory – Science Support Scale[2]

We would like to know your opinions regarding the following 58 statements about science and scientists. Please indicate the extent of your agreement or disagreement with each statement by circling the appropriate number at the right of each statement.

5 – I STRONGLY AGREE with the statement.
4 – I AGREE with the statement.
3 – I am UNDECIDED about the statement.
2 – I DISAGREE with the statement.
1 – I STRONGLY DISAGREE with the statement.

	SA	A	U	D	SD
1. One important function of science is to demonstrate the wonder and orderliness of God's universe.	5	4	3	2	1
2. It is likely that much of the scientific information we have today will be demonstrated to be inaccurate or inadequate in the future.	5	4	3	2	1
3. If one or two scientists have evidence which appears to contradict current scientific belief, they are probably wrong.	5	4	3	2	1
4. Science would be better off if scientists of Communist and non-Communist countries could work together.	5	4	3	2	1
5. Religious leaders should be constantly on guard against the ideas and theories that scientists produce and explore.	5	4	3	2	1
6. Science is bound to lead our society into godlessness.	5	4	3	2	1
7. The skepticism of the scientist should be limited to his work.	5	4	3	2	1

[2]Patricia M. Schwirian, "Construction and Validation of a Science Support Scale," Doctoral Dissertation, the Ohio State University, 1967. (Used by permission)

	SA	A	U	D	SD
8. Scientific inventions and discoveries have done more good than bad for mankind.	5	4	3	2	1
9. The administration of colleges or universities should not discharge scientists whose political views are unpopular.	5	4	3	2	1
10. An important function of the scientist today is to question what man says he believes.	5	4	3	2	1
11. There is no place in science for sexual deviants such as homosexuals.	5	4	3	2	1
12. Modern science and inventions are responsible for much of man's personal discontent and frustration.	5	4	3	2	1
13. The work of any scientist should be judged without regard for his political views.	5	4	3	2	1
14. It is not appropriate for man to tamper with the order and intentions of Nature.	5	4	3	2	1
15. The United States should encourage more students from foreign countries to study science in American universities.	5	4	3	2	1
16. Scientists should be free to explore all phases of man's life and the universe about him.	5	4	3	2	1
17. Federal scholarship programs for training scientists should be limited to citizens of the United States.	5	4	3	2	1
18. In order to be more effective, religious leaders should know about recent major advances and developments in science.	5	4	3	2	1
19. The individual scientist is the best judge of what research he should do.	5	4	3	2	1
20. Teaching machines promote improved education.	5	4	3	2	1
21. One important function of science is to teach people to be critical thinkers, not believing everyth' g they are told.	5	4	3	2	1
22. The unbounded inquiry of the scientists has had a bad effect on society's moral standards.	5	4	[illegible]	2	1
23. The primary function of a college education in science is to teach an appreciation for the findings of the past great scientists.	5	4	3	2	1
24. The questions which are really important to man can never be solved by science.	5	4	3	2	1
25. The United States government should not take on the function of directing and coordinating American science as a whole.	5	4	3	2	1

	SA	A	U	D	SD
26. The meaning of any discovery should be judged by man's moral standards rather than by his intellectual need for truth.	5	4	3	2	1
27. It is possible for a man to be a dedicated scientist and to be highly committed to his religious convictions.	5	4	3	2	1
28. Technological advances in the future will probably be nowhere as great as they have been in the past thirty years.	5	4	3	2	1
29. When the findings or theories of science conflict with religious belief it is better to accept the religious belief.	5	4	3	2	1
30. Science, rather than religion, helps rid people of superstitious fears.	5	4	3	2	1
31. While man has become physically richer from the fruits of science, he has become spiritually poorer.	5	4	3	2	1
32. The scientist's activities must not violate the basic values of his society.	5	4	3	2	1
33. Science should remain a predominantly male profession.	5	4	3	2	1
34. Fellowships and scholarships in the sciences are better spent on men than on women.	5	4	3	2	1
35. It is unlikely that a young scientist will make important discoveries.	5	4	3	2	1
36. The scientific information which has been gathered as a result of manned and unmanned space shots is well worth the large sums of money which have been spent on the projects.	5	4	3	2	1
37. The material progress of science has made men care less than they should about the prospect of eternal life.	5	4	3	2	1
38. If a student is very bright, he should be channeled into science because we need good scientists.	5	4	3	2	1
39. It would be much more pleasant to live in a country in which you didn't even know about the rest of the world's problems.	5	4	3	2	1
40. In times of national emergency a scientist's utmost concern should be for the contribution he can make to his country's needs rather than his own specific research interests.	5	4	3	2	1
41. Those who have had a history of mental illness cannot be trusted to do important scientific work.	5	4	3	2	1

	SA	A	U	D	SD
42. A return to a simpler, less mechanized life would result in happier, more contented people.	5	4	3	2	1
43. It is not always appropriate for the Federal government to demand that the scientific research it sponsors serve the national policy ends.	5	4	3	2	1
44. Scientists could work more effectively if they were organized and guided in their work by a man who has proved himself to be an outstanding scientist.	5	4	3	2	1
45. Scientific findings should not be made public if they will create social unrest.	5	4	3	2	1
46. A scientist's reputation should be as important in judging his findings as the techniques he uses in his research.	5	4	3	2	1
47. The increased efficiency of computers does not justify their use because of all the unemployment produced when computers replace men.	5	4	3	2	1
48. Scientific work should be judged primarily by the political and social necessities of the nation and the world.	5	4	3	2	1
49. Scientists could work more effectively if they were organized and guided in their work by a Congressional committee which was aware of national needs.	5	4	3	2	1
50. Men are worthy of enjoying the fruits of scientific discovery.	5	4	3	2	1
51. It is a good policy to base an important decision purely on evidence even if it is the opposite of the decision based on common sense.	5	4	3	2	1
52. The true meaning of any discovery should be judged by man's physical wants and needs rather than by his moral standards.	5	4	3	2	1
53. All miracles have a scientific explanation.	5	4	3	2	1
54. Scientists go overboard on demanding evidence before drawing conclusions.	5	4	3	2	1
55. It will be a good thing when machines free men of all manual labor.	5	4	3	2	1
56. When doing medical research, scientists should be able to collect information of a highly personal nature.	5	4	3	2	1
57. More federal support to science should be in the form of grants for general scholarship and exploratory research rather than contracts for specified product research.	5	4	3	2	1
58. In the long run, man's lot will be improved by scientific knowledge.	5	4	3	2	1

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